Project	AtlantOS – 633211
Deliverable number	2.5
Deliverable title	SOOP Network Coordination Report
Description	To report on network coordination, documenting steps taken to coordinate the network and make it robust against data gaps, delivering regular seamless data, integrated with Pan Atlantic partners
Work Package number	WP2 Task 2.2
Work Package title	Enhancement of Ship Based Observing Networks
Lead beneficiary	UNEXE
Lead authors	Professor Andrew Watson
Contributors	Jessica Thorn
Submission data	
Due date	31st July 2018
Comments	[in case the deliverable is late please explain why]

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement nº 633211.

Last updated: 14 March 2018

Stakeholder engagement relating to this task*

WHO are your most important stakeholders?	☐ Private company If yes, is it an SME ☐ or a large company ☐? X National governmental body ☐ International organization ☐ NGO others Please give the name(s) of the stakeholder(s):
WHERE is/are the company(ies) or organization(s) from?	X Your own country ☐ Another country in the EU X Another country outside the EU Bergen, Norway
Is this deliverable a success story? If yes, why? **If not, why?**	X Yes, because the University of Exeter, in collaboration with the University of Bergen, Norway, are at a stage of where we will now co-host the ICOS Ocean Thematic Centre within ICOS RI, to commence 01/01/19 ☐ No, because
Will this deliverable be used? **If yes, who will use it?** **If not, why will it not be used?**	X Yes, by other scientists, researchers, institutes and industry ☐ No, because …

NOTE: This information is being collected for the following purposes:

1. To make a list of all companies/organizations with which AtlantOS partners have had contact. This is important to demonstrate the extent of industry and public-sector collaboration in the obs community. Please note that we will only publish one aggregated list of companies and not mention specific partnerships.
2. To better report success stories from the AtlantOS community on how observing delivers concrete value to society.

*For ideas about relations with stakeholders you are invited to consult D10.5 Best Practices in Stakeholder Engagement, Data Dissemination and Exploitation.

AtlantOS WP2 Task 2.2 Ships of Opportunity Program
Deliverable D2.5: SOOP Network Coordination Report

Participant No. 24 (UNEXE) and Participant No. 12 (UiB)

WP 2.2 Summary: The network of SOOP ships currently working in the Atlantic provides a backbone of essential basin-wide observations of physical and biogeochemical parameters that cannot be measured by other means, including carbon parameters and nutrients, as well as SST and SSS ground-truth. These measurements enable, for example, monthly resolution of the net North Atlantic Ocean-atmosphere CO_2 flux, accurate to better than 20% when integrated with ARGO, satellite and physical reanalysis data, provided that coverage is coherent and well-coordinated. However, at the start of AtlantOS, the three observation networks (Carbon-VOS, FerryBox, SOOP) were not coordinated. The aim is to improve connectivity of these networks in terms of infrastructure, data standards, protocols, and utility for development of products. Initially the three networks are operated separately and potential synergies that could arise, e.g., sharing platforms, expertise, providing a continuum of observations for key EOVs from the open ocean into the coastal realm, or cross-fertilization for data products are missed. This task will therefore pave the way for future realisation of such synergies from harmonized and concerted networks.

Deliverable 2.5 Objectives: The task aims to report on network coordination, documenting steps taken to coordinate the VOS network and make it robust against data gaps, delivering regular seamless data, integrated with Pan Atlantic partners.

In this deliverable, we report below on progress towards greater coordination of SOOP activities, to deliver gap-free, sustainable observations and good trans-Atlantic and Pan-Atlantic connections. Further, we will report on progress made to work with WP7 partners to define and validate the common protocols and within the VOS network for the application of common procedures, to organise the European community to deliver a fully functioning network, and support efforts by nations to secure commitments to the Carbon-VOS network. We also report on securing the cooperation necessary to make a success of the extension to the South Atlantic and to work in close liaison with the SOCAT initiative and with the newly established ocean thematic centre of the Integrated Carbon Observing System (ICOS RI), a research infrastructure of the EU.

The major (and linked) steps reported below are:
(1) Co-ordination of the ocean observing part of the ICOS RI,
(2) Co-ordination under the auspices of JCOMM.
We also report on (3) Extension of the network in the South Atlantic.

1) Ocean observing co-ordination under ICOS RI

AtlantOS partners UNEXE, UIB and NERC have set up and co-ordinated the Oceans component of the ICOS-RI. Work under AtlantOS has contributed substantially to this achievement.

Background: ICOS is a Research Infrastructure (RI) with over 100 stations for measuring greenhouse gases aimed at quantifying and understanding the greenhouse gas balance of Europe and neighbouring regions, and covering oceans, atmosphere and land observations (see

https://www.icos-ri.eu/). In November 2015, it received the international legal status of ERIC (European Research Infrastructure Consortium) by decision of the European Commission. It is also recognized by European Strategy Forum on Research Infrastructures (ESFRI) as a landmark European research infrastructure. The aim of ICOS is to provide the essential long-term observations that are required to understand the present state and to predict future trends of the global carbon cycle and greenhouse gas emissions. It monitors and assesses the effectiveness of carbon sequestration and/or greenhouse gases emission reduction activities on global atmospheric composition levels, including attribution of sources and sinks by region and sector.

ICOS Ocean observations: A European network of ships and fixed stations monitors carbon dioxide levels in the ocean surface together with temperature, salinity and other variables as necessary to estimate carbon exchange between the surface ocean and the atmosphere, and acidification of the oceans. The impact of the infrastructure allows an enhanced visibility and dissemination of European greenhouse gas data and products that are both long-term and carefully calibrated. ICOS meets the data needs of carbon cycle and climate researchers as well as those of politicians and the general public.

Those countries that are contributing to the oceans component of ICOS have secured funding from national sources that is secure for multi-year periods, to enable continued operation of a coherent network of observations (for both surface properties and interior ocean properties, but the SOOP component is largely concerned with surface measurements). Countries currently contributing SOOP lines to ICOS are Germany, Norway, France and UK.

Co-ordination under ICOS: AtlantOS partner UIB currently hosts the **Ocean Thematic Centre (OTC)** of ICOS, which co-ordinates the network of ships and fixed stations that constitute the surface observing system. UK partners (UNEXE and NERC) are scheduled to become joint hosts of the OTC on 1st January 2019. The roles of the OTC are broadly (1) to provide a secure hosting of data from the network and integration with other ocean data (2) To liaise with the shipping industry to improve the provision of ships for SOOP operations (3) to provide technical support to the network and (4) to pursue technological improvements to enhance the network. The OTC is funded largely (80%) by national contributions from Norwegian and UK stakeholders.

The ICOS Carbon Portal provides free access to all ICOS data, as well as to links with inventory data, and outreach material. The carbon portal allows the production of web-based tools for the survey of sources and sinks in near real-time, with a quantification of the uncertainty associated with the results due to the use of several different models using different methodologies.

ICOS enables Europe to be a key global player for in-situ observations of greenhouse gases, data processing and access to data products for validation of remote sensing products, scientific assessments, modelling and data assimilation. At present, ICOS has in total 13 member/observer countries and a total of 140 stations, of which, there are currently 21 marine stations including a number of SOOP carbon-VOS lines. The station labelling process is characterised by a 3 steps process that allows stations to be recognized as having the level of standardization and measurement quality in line with the very high requirements imposed by ICOS and is managed and coordinated by UiB, Norway.

1, the Joint Technical Commission for Oceanography and Marine Meteorology. JCOMM is an intergovernmental body that provides a mechanism for international coordination of oceanographic and marine meteorological observing, data management and services to the meteorological and oceanographic communities. Discussions have commenced in early 2018, in merging the European carbon-VOS line and SOOP with the global VOS line and SOOP networks, housed under JCOMMOPS.

2) Co-ordination under JCOMM

We have worked outside Europe to advance the co-ordination of the Atlantic Ocean SOOP observations with global partners, under JCOMM.

Background: The Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM: https://www.jcomm.info/) is the organisation charged by IOC and WMO which co-ordinates met-ocean observations and data requirements. JCOMMOPS (www.jcommops.org) acts globally, as a focal point for implementation and operation of relevant observing platforms and for the practical coordination of the in-situ ocean observing systems defined by JCOMM. JCOMMOPS routinely provides information of the functional status of the observing systems and encourages platform operators to share data and to distribute it in real-time. Furthermore, JCOMMOPS provides a mechanism for relaying quality information from data centres and users worldwide, back to national platform operators. It encourages the harmonisation of metadata and vocabulary between research and operation communities.

Co-ordination developments: JCOMM-OPS has not hitherto formally embraced the Carbon observing SOOP lines, but this is in process of changing. A meeting of investigators was held at the beginning of 2018 In Portland OR, USA convened by actors including scientists from NOAA, IOCCP and UNEXE. This set up a new voluntary organization, now christened SOCONET (surface ocean CO_2 network). SOCONET is now developing an inventory of platforms worldwide that make surface ocean carbon observations, with tracking of those platforms and data following established network principles modelled on the met and ocean data networks under JCOMMOPS, and will become a component network recognised by JCOMMOPS. This will enable much closer integration of CO_2 SOOP operations with other marine observation networks

3) VOS network coordination, general comments:

We are in regular communications with the shipping industry (see especially under OTC, above) and are making efforts to improve the coherence of the network and its sustainability into the South Atlantic Ocean. However, a major issue for our observation effort is that rapid changes in the shipping industry are negatively impacting the SOOP network: whereas historically, vessels were usually committed to routes for extended periods, this is rapidly becoming a rarity, with the industry moving towards general purpose container vessels that change routes continuously. The frequent changes in routes make it very difficult to maintain an observing network with regular time series on a given route, due to the labour and costs associated with continually re-installing scientific instruments on board vessels for short periods of time. The successful routes on which it is proving possible to sustain time series are mostly vessels operated for strategic, rather than purely commercial, reasons. For example, two of the most reliable routes are from Denmark to Greenland operated by the Royal Arctic line under a long-term contract with the government of Greenland, and the MN Colibri, which is a specialist ship built to transport rocket components from France to the launch site in French Guiana.

4) Status of South Atlantic network

We have found it especially difficult to locate available vessels that run for extended periods through the South Atlantic Ocean. The current (March 2018) status of the coverage in the South Atlantic is: (1) A regular line France-Brazil is running (IRD/CNRS); (2) After extensive negotiations and several delays, a shipping route operating between the UK and the Falklands Islands in the South Atlantic has been operating since April 201, and the first roundtrip voyage has been completed (NERC); (3) Despite extensive efforts by PLOCAN, no line from Europe to S. Africa through the eastern South Atlantic is currently running; (4) Use has been made of voyages by research vessels to obtain opportunistic South Atlantic coverage (NERC).

5) Carbon-VOS network database:

As part of information exchange across the VOS network, the University of Exeter have developed a carbon VOS network database, housing information covering all shipping lines, routes, parameters measured and a log of instruments used across Europe. This is an everevolving project and is continually amended with updated and additional information over time. It is envisaged that this valuable information will be eventually integrated into JCOMM, on a global level of coverage for information exchange.

Integration with other work packages and initiatives:

We are working with AtlantOS work package 7 partners to define and validate the common protocols within the VOS network for the application of common procedures. All measurement data are quality controlled through the ICOS thematic centres and submitted to the ICOS carbon portal where they are made available as research data and as science and educational products (https://www.icos-cp.eu/). Data are also made available via SOCAT (The Surface Ocean CO_2 Atlas). SOCAT is a voluntary activity by international marine carbon scientists and is currently at Version 6, with 23.4 million quality controlled in situ surface ocean fCO_2 (fugacity of carbon dioxide) measurements for the global oceans and coastal seas, as well as additional calibrated sensor fCO_2 measurements. The data is made freely available via their website (www.socat.info).